AGRICULTURAL Research

NOVEMBER 1954

Winged farmhand

AGRICULTURAL
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JOSEPH F. SILBAUGH—MANAGING EDITOR

TESTIMONIAL

A refresher came in our mailbag.

It was a letter from a scientist who—as so many others have done through the years—had just retired after an outstanding research career in the United States Department of Agriculture.

Dr. Eugene S. Schultz had been continuously engaged in the investigation of potato diseases since 1917. His work greatly benefited the potato industry through improvement of seedstocks and development of late-blight-resistant and mild-mosaic-resistant varieties. He became a world authority on virus diseases of potatoes.

The Potato Association of America elected Dr. Schultz Honorary Life Member in 1949. In 1952 he received the Maine Potato Industry Honor Award. And in 1953 USDA bestowed its Superior Service Award.

Retirement came last summer, after 39 years. Dr. B. T. Shaw, ARS Administrator, wrote Dr. Schultz to thank him for his service and to wish him health and happiness. Here is his reply:

"Many thanks for your letter expressing your appreciation of my services in the Department of Agriculture.

"You may be interested to know that I thoroughly enjoyed my work in the Department, which to my knowledge is second to no other institution in granting freedom for the prosecution of research and for rendering unlimited service.

"I agree completely with one of my former executive officers who remarked that he always regarded it a great mistake for a research worker to leave the Department before he was due for retirement."

That's an eloquent answer to the popular notion that scientists are generally dissatisfied with the Government as an employer. Researchers are said to be not only underpaid but also stifled by administrative chores, red tape, restrictions of team research, and so on.

It's apparent, however, that the day-to-day annoyances of getting a job done didn't blind Dr. Schultz to the many advantages that enabled him to achieve major objectives. We believe he expresses the sentiments of much of the research staff of the Department of Agriculture.

This testimony, coming from a researcher with an outstanding record, deserves the consideration of students and young scientists.

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

Winged farmhand

AIRPLANES are doing more jobs for agriculture than ever before. Researchers are helping develop the aircraft, equipment, and methods to do these jobs better and safer (story p. 8).

Contents

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Proof OF PARTHENOGENESIS

EMBRYOS can develop in *unfertilized* turkey eggs. USDA research workers have at last proved the point to their satisfaction.

Any doubt remaining after the phenomenon was accidentally discovered by ARS poultry scientists M. W. Olsen and S. J. Marsden (AGR. RES., Aug. 1953, p. 4) has now been dispelled by further experiments at the Agricultural Research Center, Beltsville, Md.

These experiments, conducted with extreme care so as to avoid any chance of error, not only demonstrate that parthenogenesis (embryonic development in unfertilized eggs) does exist—they also show that the incidence is greater in the eggs from some turkeys than from others.

To verify parthenogenesis, Olsen segregated 79 virgin Beltsville Small White females from their immature male pen mates before they were 6 weeks old (sex was positively determined by operational examination).

The females were housed in a locked building in pens remote from other turkeys. Olsen had the only key to the pens, and the care of the birds and gathering and incubation of the eggs were solely his responsibility. These and other precautions, such as marking the eggs in code with invisible ink, were taken because flocks of mated turkeys were being maintained in the same general area.

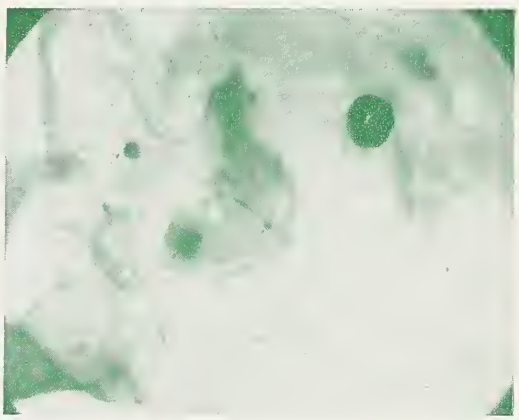
Olsen gathered and marked the eggs each evening and placed them in a locked incubator in which the temperature was maintained at 99½° F., the relative humidity at 57 percent.

Earlier studies had shown that parthenogenic development can't be seen with a candler before about the fourth day of incubation, compared with 18 to 24 hours in most fertile eggs. So eggs from these virgin hens were candled for the first time on the ninth day of incubation. Eggs showing signs of development were returned to the incubator. The others were removed, broken out, and examined for evidence of development.

The 79 hens laid 2,537 eggs during the 8-week experiment. Out of this number, 568 or 22.4 percent showed parthenogenic development:

1. In 27 of the 568 eggs, *embryos* and *blood vessels* were found. These eggs, in terms of equivalent development in normal eggs, attained various stages: 8 embryos, 2 to 3 days; 11, 4 to 6 days; 3, 9 to 10 days; 1, 14 days; 1, 18 days; and 3, 26 to 27 days. With one exception, embryos that de-

PERFECTLY FORMED, this parthenogenic turkey embryo missed hatching by about 2 days. It lived 30 days—2 more than normal incubation period of fertile eggs—and showed development equivalent to that of a normal embryo at 26 days. Of 568 parthenogenic eggs in the 1954 test at Beltsville, 3 reached this stage.



USUAL PATTERN of parthenogenic embryos in nonfertile turkey eggs was followed by this one: After 9 days of incubation, it shows development equivalent to that in a fertile egg after 6 days of incubation. At Beltsville, 22.4 percent of the eggs that turkey hens laid in the 1954 test showed parthenogenic development.

veloped to or beyond the equivalent of a normal 9-day embryo appeared to be perfectly formed.

2. In 492 of the 568 eggs, parthenogenic development was limited to *extra-embryonic membranes.* These, however, frequently covered nearly the entire surface of the yolk.

3. Development in the other 49 eggs reached the stage of readily discernible *blood islands* or *vessels.*

The 22.4 percent incidence of parthenogenesis in the 1954 test compares with 16.7 percent in 1952 and 14.1 percent in 1953. This increase is the result of selection, for purposes of the test, of Beltsville Small White females with a strongly developed trait of producing such eggs. The figures from the two earlier experiments are believed to be closer the average incidence of parthenogenesis found in normal flocks of Beltsville Small White turkeys.

The phenomenon has also been observed in eggs from Broad Breasted Bronze and Light Palms turkeys, running 11.5 percent in both cases.

Of considerable importance to turkey breeders and growers is this finding in the 1954 experiment: very few of the virgin females on test failed to produce some parthenogenic eggs; some of the hens produced only a few; and more than 20 percent of the eggs laid by a considerable number of the hens were of this type.

This strengthened Olsen's belief that production of parthenogenic eggs is an inherited trait that probably can be controlled by selection. Another indicator is the fact that the test hens laying the greatest number of parthenogenic eggs were the progeny of one male Beltsville White turkey.

Current experiments at Beltsville should yield further evidence as to whether the trait is inherited. The scientists are using two distinct lines of Beltsville Small White turkeys—one line producing a high incidence, the other line producing a low incidence of parthenogenic eggs.☆

Now—a test for Lymphomatosis

USDA RESEARCHERS HAVE FOUND A WAY to detect the cancerous disease visceral lymphomatosis in live chickens—a discovery termed "highly significant" by Berley Winton, head of the Regional Poultry Disease Laboratory at East Lansing, Mich., (AGR. RES., June 1954, p. 4).

Previously, the only reliable diagnosis of visceral lymphomatosis (sometimes called "big-liver disease") involved post-mortem examination of chickens for lymphomatous tumors on internal organs.

This development by ARS poultry-disease scientists S. Lesher (now associated with Argonne National Laboratory) and B. R. Burmester grew out of earlier research by J. W. Beard and coworkers of Duke University. Basis of the test is their discovery that the virus causing a leukemia in chickens contains an enzyme that will react with the chemical *adenosine triphosphate.* This enzyme, known as *adenosine triphosphatase* and a constituent of all animal cells, increases greatly in the plasma of chickens during the growth of leukemia or lymphomatous tumors.

The test works like this: a measured amount of chicken plasma is added to a prepared solution containing adenosine triphosphate and an acid indicator. The enzyme in the diseased plasma reacts with the adenosine triphosphate, stripping it of a phosphate ion within 20 minutes. This causes the solution to become slightly acid. With plasma from healthy birds, acidity doesn't show up for 30 minutes or longer.

In laboratory tests with chickens that outwardly appeared healthy but were tumorous, the enzyme-activity test gave a correct diagnosis in 40 out of 42 cases. Nearly 300 healthy chickens gave negative responses.

Winton considers this discovery an important step forward in the search for knowledge about lymphomatosis—poultry's worst disease. Like human cancer, it has resisted man's research efforts to find a cure.

Practically, the test may help researchers identify visceral lymphomatosis in chickens to be used in disease-transmission and immunity studies. It may lead to development of an effective warning diagnosis to tip off flock owners of the presence of this highly infectious disease. It's not known, says Winton, whether the test will prove of value to scientists studying virus-caused tumors in other animals.

Answers to some of these hopes lie in further research that will show whether or not this test will work on chickens that are infected with the virus but haven't yet developed tumorous growths—or at what stage of tumor development the test does become effective.

(*Visceral* lymphomatosis is top killer and hardest to detect of three forms. *Neural* lymphomatosis—fowl or range paralysis—is next biggest killer and easiest to detect. *Ocular* lymphomatosis attacks the eyes.)☆

SALT HITS EASTERN IRRIGATION

IRRIGATION supplied plenty of water, yet "burned up" crops on many Atlantic-Coast farms last summer. Trouble was that the water had salt in it—an old story in the West but comparatively new in the East.

This problem has led to a much-needed study, now being planned, of the injury to plants from salty waters sprayed on foliage.

Soil scientists C. H. Wadleigh and M. S. Anderson, of USDA's Agricultural Research Service, recently tested the soils and irrigation waters in several severely damaged fields in New Jersey and Delaware. Both soil and water contained hazardous salt concentrations—especially sodium chloride, and usually from the ocean.

Drought-like symptoms appeared in the midst of water, a condition familiar to western irrigators. Furthermore, crop leaves showed striking physiological damage, attributable to contact with a toxic material.

Salinity has been an irrigation problem in Florida for 10 years, but the 1954 drought exposed it further northward. For one thing, more water was put on the crops. And, owing to drought, brackish water extended further inland in coastal creeks. Moreover, some geological formations along the coast carry water of appreciable salt content. Wells supplying such water for irrigation may injure crops in certain areas.

The problem may be different under eastern spray irrigation than in the West, where furrow or flood irrigation predominates. Spraying provides two points of intake by plants—the leaves and the roots. Western soil scientists know that when salt in irrigation water reaches about 500 parts per million, trouble may be expected. It's not known whether direct application of water on leaves lowers this safe salinity limit.

Crops draw water in through root-cell walls by a process called osmosis. Both the root cell and the soil contain salts in solution, and this solution must be *more concentrated in the cell* if osmosis is to bring water into the plant. The greater the salt concentration in the cell as compared with that of the soil, the stronger the osmotic pull of the plant. On the other hand, pronounced soil saltiness reduces the plant's osmotic advantage—sets up resistance to the plant's force for lifting water.

When salty irrigation water is used, the *water* disappears by surface evaporation or through the plant and leaves salt behind. Eastern rains normally wash the salts down beyond plant reach. But in the West's arid climate and the East's extreme droughts (such as last June and July on the Atlantic Coast) salt stays in the upper soil, increases the concentration of the soil solution, and causes it to resist normal osmosis. "Physiological drought" sets in. The plant stops growing and may die.

Western irrigation waters may add from 1 to 6 tons of dissolved solids per acre per year. And in the East, a Salem, N. J., farmer irirgated his alfalfa last summer from a creek carrying more than 700 pounds of salt per acre-inch of water. A Middlesex County, N. J., well had more than twice this salt content. Salinity is thought to be fairly widespread in eastern coastal creeks. A survey by the State of Florida showed numerous irrigation wells carrying saline water—one at Courtenay, for example, contained about 1,900 pounds of salt per acre-inch.

The leaf-burn problem didn't attract attention until sprinkler irrigation came into wide practice in the East, largely since World War II. So we know little about it. A study of the problem is being started at the ARS Salinity Laboratory, Riverside, Calif. Scientists will investigate the nature of the leaf injury and the effect of various concentrations of salt on a large number of crops.☆

NEW SYSTEMICS: answer to cotton insects?

OUR SEARCH FOR BETTER WAYS of killing cotton insects has turned up some promising new systemic insecticides that are lethal not only to certain sucking insects but also to such plant chewers as the boll weevil and cotton leafworm.

Unlike the more common insecticidal sprays and dusts that form a protective layer over the outside surface of the plant, systemics are absorbed into the plant and carried by its sap. They may be applied to foliage, soil, or seed. In this way, the stalk, the foliage, and sometimes the fruit of a plant can be made toxic to feeding insects by treatment with an effective systemic.

Systemics aren't new to some cotton growers. A few may have used systemics as foliage sprays or dusts against sap-sucking aphids and mites. But the chemicals under tests are the first that also kill insects that chew at stalks, leaves, and fruits.

In cooperative tests by USDA and the Texas experiment station, two of these systemics were applied to the foliage, to the soil, and to the seed. They proved lethal to the cotton boll weevil, the cotton leafworm, and the cotton leaf perforator (all chewers) and to the cotton aphid and the spider mite (suckers) for more than a month *under laboratory conditions*. When applied to cotton planting seed *in field tests*, both compounds gave protection against thrips, aphids, and spider mites for more than a month.

Called, for convenience, L–11–6 and 12008, these chemicals are, respectively: O,O–diethyl S–ethyl mercaptomethyl dithiophosphate and O,O-diethyl S–isopropyl mercaptomethyl dithiophosphate. Of these, the S–ethyl compound appears to be toxic to cotton pests over a longer period. Other mercaptomethyl dithiophosphates have also been effective against certain chewing insects, but thus far none has been as successful as L–11–6 and 12008.

ARS entomologists emphasize that research with these systemics is still in the early stages and that their desirability is not yet proven. It's still necessary to work out a dependable method of seed treatment that won't lower germination—also to find out how the new chemicals affect plant growth and to what extent they can build up injurious chemical residues in the plant. Moreover, the new chemicals are not yet available to growers.

So the entomologists advise cotton growers to stick by current recommended methods of insect control for the present and continue to apply insecticides as foliage dusts or sprays.☆

Sulfur may run low in southern soils

SULFUR DEFICIENCY occasionally shows up in cotton and some other crops in the South, and preliminary studies suggest that increasing use of low-sulfur fertilizers might eventually lead to widespread sulfur shortages.

Soil scientist H. V. Jordan of USDA's Agricultural Research Service, and scientists in 12 southern experiment stations and the Tennessee Valley Authority cooperating in a regional sulfur research project, have opened up the problem with some inconclusive findings from 1 year of study.

Field experiments with cotton and other crops at 23 locations showed that some of the crops sometimes responded to sulfur additions during early growth. But all differences disappeared by harvest. Analysis of the soils showed that the *plow layer* usually is low in sulfur, the *subsoil* much richer in it.

It appears that young plants are sulfur-starved when their roots are feeding from the plow layer. Later, as their roots tap the subsoil, the plants get enough of the element—a fact previously observed in Alabama.

Analysis of rainwater at 64 sites showed that only about 6 pounds of sulfur per acre is usually brought down in a year (except where local coal-consuming industries release a great deal of sulfur into the air). This is much less than sulfur-sensitive crops need.

Though the newer high-analysis mixed fertilizers usually contain some sulfur, they have far too little for plant needs. To get richer nitrogen and phosphorus sources, mixed-fertilizer producers substitute various low-sulfur ingredients in place of the traditional ammonium sulfate (about $\frac{1}{4}$ sulfur) and superphosphate (about $\frac{1}{10}$ sulfur).

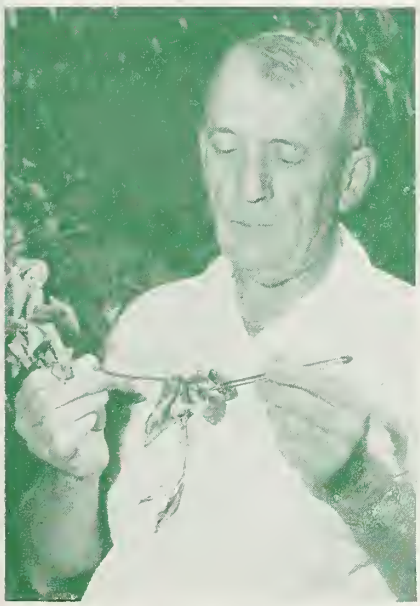
Studies show that wide use of fertilizers containing little or no sulfur might eventually cause widespread soil deficiencies of this element in non-industrial areas. But it may take several years to exhaust the subsoil supply. When this happens, farmers will need to supplement their high-analysis fertilizers with extra sulfur. Even so, economics probably will still favor the high analysis.☆

ANTIBIOTICS ARE STOPPING FIRE BLIGHT

ANTIBIOTIC MIXTURE streptomycin-terramycin controls fire blight, leaves pears unrusseted (right). Fruit treated with copper sulfate (left) becomes discolored, rough-skinned—loses grade in fresh market. (Fire blight has been controlled, with some success, by use of copper sprays and dusts, coupled with cutting of blighted branches.)

A PEAR ORCHARD with only 1 fire-blight infection in every 6 trees looks quite different from an orchard with 9 infections *per tree*.

That's the contrast USDA scientists found when they checked unsprayed control plots against plots sprayed with antibiotics in an experiment this year. Streptomycin and mixtures of streptomycin and terramycin were the test materials.



FIRE BLIGHT infection on pear tree is inspected by J. C. Dunegan. This disease has helped drive pear cultivation westward, remains constant threat to the fruit industry.

ARS pathologists J. C. Dunegan, J. R. Kienholz, R. A. Wilson, and W. T. Morris conducted this experimental work with antibiotics. They were trying to determine the *commercial* feasibility of using antibiotics to control fire blight—one of the bacterial diseases that threaten pears. The experiment covered 600 Bartlett pear trees at Marysville, Calif.

Earlier research has included, besides spraying, direct injection of fruit trees with antibiotics (AGR. RES., March 1954, p. 10).

Exploratory tests at Beltsville, Md., in 1952 showed streptomycin was relatively non-poisonous to pear leaves. Small-scale field trials in 1953 in California and Oregon demonstrated that the antibiotic applied as a spray (at 100 parts per million) reduced fire blight, didn't russet the fruit, and caused only mild blanching or yellowing on some leaves.

Pathologists found this year that blight control obtained with 5 or 7 applications of the streptomycin-terramycin mixture (30 parts and 3 parts per million, respectively) was as good as results with tri-basic copper sulfate spray. Higher concentrations (100–10 and 60–6) were significantly better. It was at these highest concentrations that only 1 infection appeared in every 6 trees.

Dunegan estimated that 600 gallons per acre of the 30-parts-per-million spray, applied five times at 7-day intervals, would cost approximately $68 per acre per season (assuming an antibiotic cost of 20 cents per gram activity). Loss per acre from copper injuries in some California pear orchards is higher than this figure in most seasons. In these orchards, use of antibiotic material for blight control is commercially feasible.

To obtain the same results with three applications (at 14-day intervals) of 100-parts-per-million spray would cost $138 per acre per season.

For spray work, 38 grams (slightly less than 1½ ounces) of the antibiotic dissolved in 100 gallons of water gives a solution containing approximately 100 parts per million.

Little information is available on how antibiotics produce the results observed. Pathologists do know that the antibiotics are absorbed, move through the trees, and in some way prevent bacterial infections from becoming established.

Commercial feasibility of their use in western orchards will depend on the cost of the antibiotic materials in relation to the amount of fruit injury from present control practices.☆

Research helps

Agricultural aviation

do 3 kinds of jobs better

ON December 3 and 4, the second USDA-sponsored Agricultural Aviation Conference will bring together in Chicago agricultural research workers . . . Extension Service, Weather Bureau, Civil Aeronautics, and Army personnel . . . commercial applicators . . . manufacturers of equipment, planes, and agricultural chemicals. They will swap experiences, report on current research, talk over plans for use of aircraft in agriculture. Such conferences become increasingly important as research in this exacting and ever-changing field expands.

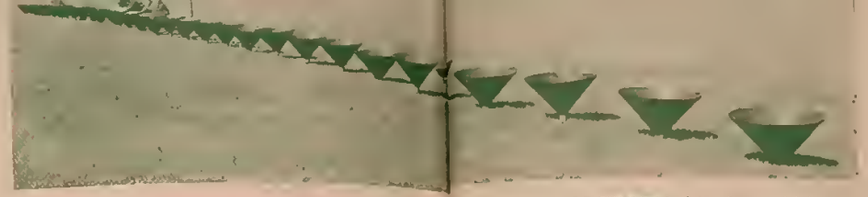
Country cousin of the aircraft industry, agricultural aviation has grown up in made-over castoffs of military and commercial aviation. But the surplus training planes adapted for spraying and dusting after World War II are wearing out. Now a few planes are being designed and manufactured specifically for agricultural aviation.

USDA engineers have given assistance and suggestions, particularly on dispersal equipment, to companies designing aircraft for agricultural work. Two experimental agricultural planes have been cooperatively built, primarily by research agencies—the "Ag-1," built for the Civil Aeronautics Administration by Texas A. and M. College, and the "Ohio Project," an applicator plane first flown this past February.

Research workers feel that aviation design, now aiming for greater speed and altitudes, must make a sharp turn or even backtrack if we are to have a basic agricultural aircraft. Such a plane needs to travel at slow speed and low altitude, climb from and land—sometimes vertically—on small or makeshift airstrips, and turn easily.

Dispersing chemicals keeps commercial aircraft busy in most areas for only a short season. Purely agricultural planes might be too costly unless adaptable to many uses. Some research workers visualize a "flying truck" that can dust, spray, haul and dump feed, transport passengers, and perform a dozen other farming or ranching chores.

Workers are so few in this many-pronged field that most research is cooperative among Federal, State, private, and industrial agencies. Transfer of the ARS Aircraft and Special Equipment Center to the Agricultural Research Center at Beltsville, Md., this year allows closer coordination of USDA's aerial research and dispersal work.



NOZZLE BOOMS of dual spray equipment—two tanks, pumps, and so on—distribute in flight two sprays simultaneously, one dyed red, the other blue. Spectrophotometer sorts out the 2 sets of drops on samples and reveals more reliable deposit pattern, regardless of wind effects. Six aerial spray flights did the work of up to 60 single-unit-sprayer flights.

ROWS OF FUNNELS show how widely and evenly plane disperses granular materials. Such materials blew or bounced out of trays or plates. Iron stakes hold funnels; paper cups underneath collect falling granules, shield them from wind; funnels' sloping sides prevent bounce-out. Deposits from numbered cups are poured into vertically mounted glass tubes; height of material marked on graph paper behind tubes quickly gives deposit curves. Special Equipment Center personnel have adapted aerial dispersal equipment to spread granular materials. Seed and pelleted or granular material is usually less affected by wind than are dust or spray, penetrates foliage better to reach soil. Heavy granular particles, unlike light, wide-spreading dusts, tend to fall straight down in a narrow swath. Some research is aimed at development of a wider-projecting distributor of such particles.

1 Spraying, dusting, and distributing granular materials

One problem in applying agricultural dusts is to get an even flow of material from the hopper. Dust tends to come out first in large quantities, then peter out as pressure behind it lessens. A fluidizer that makes dry bulk materials behave like liquids has been developed and is being improved by ARS agricultural engineers. Air forced up through a tank of pesticide diluent expands the dust to an easy flowing, liquid-like mass that can be metered and carried through small tubes or pipes by maintaining a pneumatic pressure within the dust tank. Dusting is the oldest use of aircraft in crop production.

The boom-and-nozzle sprayer for dispersing liquid insecticides from the air was designed by USDA personnel in 1943. Though modified and adapted many times, it remains the standard type of general-purpose sprayer.

Experimenting with aircraft is costly. As much work as possible is done on the ground. But when work reaches flight-test stage, duplicate flights are usually needed for comparative results. It is well-nigh impossible, however, to duplicate weather conditions for two flights. That's why dual spray equipment (pictured at left) was developed in the U. S. Forest Service for testing aerial sprays for forest insect control.

Dispersing seed, pelleted fertilizers, and granular insecticides—a new and growing use of aircraft—is prompting research into better ways of distributing heavier-than-dust dry material (photo, top left).

AERIAL OBSERVER uses line-strip method to record insect damage. Observer looks out between view-limiting strips on plane's glass door. Electrical keyboard controls 20 pens of operations recorder. Amber face shield filters yellows of insect-ridden foliage, heightens greens of healthy trees, and neutralizes blues and violets of haze and mist.

2 surveying and mapping

As a flying observation platform, the plane is becoming more and more useful in detecting and appraising the depredations of forest insects. It's the only possible way to survey some areas.

Sketch mapping on existing aerial photographs is the usual method of recording surveyed insect damage.

Forest Service research workers, however, have developed a line-strip method that has proven fast, economical, and accurate in recording the damage of several forest pests. Flying over a sample forest area, two observers record on moving charts the lines and dots that indicate degrees and extent of foliage faded, discolored, or destroyed by insects (photo at left).

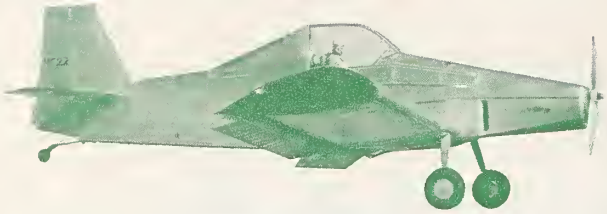
Entomologists hope to improve these strip viewers, perhaps through the combined use of operations recorders with small aeronautical charts.

Forest insect research personnel last year developed a clinometer device that measures horizontal distance from airplane to points outboard from the flight line. It works something like the hypsometer—used by foresters to determine tree heights—but turned upside down to measure horizontally instead of vertically.

Trying to cut aerial photography's high cost, Forest Service researchers took sets of two color pictures on 16-mm. film a few seconds and several hundred feet apart to get a stereoscopic effect when viewed together. If this technique is successful, photography by automatic 35-mm. camera may prove economical for sample strip surveys. A portable light table to stereo-view color transparencies has been developed for field use.

A promising new use of airplanes in mapping is being explored in Soil Conservation Service. In the past, soil maps have been made either from aerial photos supplemented by soil examination on the ground, or by use of stereoscopic pairs of aerial photographs. A third method, the airplane method, is developing from pioneer tests made in Minnesota in 1952 and 1953 in cooperation with Minnesota's Agricultural Experiment Station and Department of Aeronautics.

With map board and pencils, the soil scientist is flown 500 to 2,000 feet above the area to be mapped. He sketches boundaries of different soils on an aerial photograph. Resulting maps closely depict actual soil patterns (when differences are reflected in plow layers) and can greatly reduce ground observation.



PROTECTIVE EQUIPMENT of A–1 featured special seat, safety belt, and shoulder harness for pilot, as well as structural members and crash tripod above high-visibility cockpit. Leading edge of the landing gear was made sharp to cut wires. All the loads and heavy masses were located in the wings or forward of the cockpit.

LIGHT-WEIGHT RESPIRATOR protects handler of toxic insecticides. Two white filters stop dust or spray; cartridges beneath take out the toxic fumes. Gloves, cap, liquid-repellent coat, and the one-piece, wide-vision goggle give additional protection. Both pilots and ground crews use such equipment when needed.

MANEUVERABLE, AUTOMATIC-OPENING 33-foot parachute developed in Forest Service provides better support and slower landing for 235 pounds of heavily padded smokejumper and gear than 28-foot chute used in the Army to carry average 170-pound man. Forward expulsion of air causes the billowing effect on tails.

3 Protecting pilots, handlers of materials, and smokejumpers

Safety of pilots, observers, ground personnel, and everyone else working in agricultural aviation continues a prime research object. No permanently employed USDA personnel have yet been killed or seriously injured in aerial phases of forest-fire fighting or plant pest research or control. Even the forest-insect survey crews now wear parachutes and are trained in smokejumper techniques of bail-out and let-downs from tall trees. They learn to evacuate and clear a plane in only 25 seconds.

To make aerial spraying work safer, USDA research workers are experimenting with flights at greater and greater heights.

ARS chemists, working closely with Civil Aeronautics Administration personnel, are constantly developing and testing respiratory devices that will give protection against new insecticidal sprays and dusts. When insecticides from poison gases developed in Germany were first tried out in this country after World War II, there was no breathing device available to protect users. To answer this need, the Department developed the light-weight respirators now commonly used. Worn over the nose and mouth, such respirators filter or absorb toxic fumes from the air.

Discussed but not yet developed in this field is addition of foul-smelling chemicals to the less odorous pesticides to assure quick detection of leaks in protective breathing equipment.

The Aircraft and Special Equipment Center is testing a non-flammable replacement fluid for hydraulic drive systems that operate aircraft spray pumps. Fires in spray aircraft with hydraulic drive systems have caused some insurance companies to quote a higher rate for planes so equipped.

The fact that the pilot of the Ag–1 walked away from its wreckage when it crashed in a demonstration flight in 1953 was dramatic proof of the effectiveness of this plane's crash-injury protective equipment. The equipment was especially developed for the Ag–1, first airplane designed exclusively for farm use. It was sponsored by the Civil Aeronautics Administration, cooperating with USDA and a number of other agencies. The company that purchased the Ag–1 has incorporated its most desirable features in designing a new agricultural plane, the Ag–2.

Much of Forest Service's aerial research on fire control is concerned with making smokejumping safer. Techniques and equipment of military parachutists can't always be used by heavily padded fire-fighters who must often precision-land on a small mountaintop or in a remote, heavily forested area.

The Forest Service is currently looking for a quick test to show when a parachute is no longer safe to use; developing a new low-weight, high-strength harness (the critical link that first shows wear); and adapting a band for the auxiliary parachute (carried on the chest) to make it open quicker, oscillate less, and flatten out more for slower descent.☆

Goats can use urea substitute with protein supplements high

It's practical to feed urea to goats when protein concentrate prices are high. USDA animal nutritionist Ivan L. Lindahl and associates found urea a satisfactory protein replacement in feeding trials conducted by ARS from last November to July—the first long-time experiment ever made on urea feeding of goats.

Protein concentrates are usually the highest priced ingredient of a goat's diet. Urea, on the other hand, can be manufactured in abundant quantities and at prices that may be considerably lower than "protein equivalent" from the conventional concentrate sources.

The researchers weren't sure goats would eat urea—contrary to popular belief, they're fussy about their food—but the tests proved they found it palatable.

Urea must be used sparingly. If more than 3 percent urea is fed in the concentrate mixture or 1 percent in the total diet, animals may develop an often-fatal malady similar to ammonia poisoning. The experimental diet contained only 2.2 percent urea in the concentrate. But this small amount of urea plus 17.8 percent of corn replaced 20 percent of linseed meal that was used in the concentrate part of the control diet.

Goats on a diet of corn, barley, wheat bran, black strap molasses, salt, bonemeal, and linseed meal showed about the same weight gains, number and weight of kids dropped, and milk and butterfat production as did goats on the experimental diet that substituted urea for linseed meal. Both these diets were pelleted.☆

Guar bean gives good results as home-grown feed for steers

Guar beans from India, grown for a number of years in the United States as a soil builder and vegetable gum source, seem to have promise as a home-grown protein supplement for steer calves wintered on grass.

This progress report comes from a 3-year study under way at USDA's Southern Great Plains Field Station, Woodward, Okla. Steers fed guar beans (pronounced gwar) from December until April slightly outgained others fed cottonseed or soybean pellets as protein supplements, says ARS range agronomist E. H. McIlvain.

In 158 days, the guar-fed calves gained 135 pounds compared with 117 pounds gained by those on cottonseed and 123 pounds by those on soybeans. How much of this gain on guar-bean supplement was due to carbohydrates in the beans and how much to protein was not determined. Guar-fed steers also showed more bloom—the cattleman's term for good finish or general condition.

The guar beans were rolled to a fairly coarse state at a custom feed mill. Cattle slow to accept the rolled beans came to like them after a short transition period in which beans and cottonseed meal were mixed.

In these first tests, the guar-fed weaner steers got 3.5 pounds of rolled beans daily. Two other lots of steers got an equivalent amount of protein in 2 pounds of either 41 percent cottonseed or soybean pellets.

This winter, various lots of steers will be fed the same weight—2 pounds—of guar beans, cottonseed, or soybean pellets daily. This will give the researchers comparisons based on approximately equal costs.

The Asiatic guar bean is a drought-resistant summer annual, adapted to sandy loam soils in those areas of the Southwest where cotton and sorghum are grown.☆

Quarantine officials look out for any new scrapie outbreaks

The last known source of scrapie disease—deadly menace to the American sheep industry—was destroyed in Vinton County, Ohio, September 10.

The 117 sheep in Vinton County that were either infected or exposed to scrapie were slaughtered and the carcasses disposed of under USDA supervision, so as to prevent further spread. There's no known cure.

Thus, 7 years after this paralyzing and fatal disease first appeared in the United States, there is hope that our vigorous quarantine and eradication program has eliminated scrapie (AGR. RES., May–June, 1953, p. 6).

But the disease may be harbored in healthy-looking sheep for as long as 3 years. So it will be some time before we can have complete assurance that the disease has been eradicated. Meanwhile, quarantine officials of ARS and cooperating States will keep close watch over all localities where the disease had been detected. It's thought that scrapie may also attack goats.

A complete report on this disease—symptoms, how it spreads, history in this and other countries—may be obtained by requesting "Scrapie" from Agricultural Research Service, USDA, Washington 25, D. C.☆

It takes good forage

AMERICAN DAIRYMEN may be giving their cows too much grain. Grain feeding has increased about 25 percent in the past 7 years—a change that has added materially to the cost of producing milk.

USDA dairy nutritionists believe feeding costs—normally at least half of the total cost of milk production—can be cut 20 to 25 percent by using more forage. This is indicated by forage-feeding studies conducted cooperatively by ARS and Michigan State College scientists on 34 southern-Michigan dairy farms.

But the savings depend to a large extent on the *quality* of pasture, hay, or silage used. High-quality forage has a high level of TDN—the total digestible nutrients that make it more than just a "cow filler."

Studies under the direction of ARS dairy research chief R. E. Hodgson bring out this point: income over feed cost and rate of milk production are more favorable when the quantity of good forage fed is about 2½ times the weight of grain used. It has also been shown that the cost of producing milk turns sharply upward when forage makes up only a little more than half of the total ration.

These findings suggest that the high level of production obtained by heavy grain feeding isn't necessarily the most profitable level. Greater dependence on high-quality forage will likely cut production costs.

One of the big problems, however, is making certain that the forage fed to cows *is* of high quality—that it has the necessary TDN.

Researchers are now looking for ways of producing, preparing, and using high-quality forage. This work includes development of better grasses and legumes, improved forage mixtures for various areas, and better methods of grazing, harvesting, and handling these crops so as to produce and hold a high level of TDN. In addition, studies are being made on fertilizers and irrigation in growing forage crops, and the effect of these practices on milk production.

Dairy nutritionists have found that pasture is the most efficient form of forage for offsetting heavy grain consumption. Thus, keeping pastures highly productive—through choice of the proper grass and legume mixtures, fertilization, and irrigation—is important in maintaining the TDN level for milk production.

Experience shows that good pasture mixtures of grass and legumes give heavier yields and provide more protein than either grasses or legumes by themselves. Liberal fertilization also helps produce good forage crops and increases the TDN per acre. In fact, the combination of fertilization with good grazing and cutting practices has increased pasture yields 50 to 100 percent in actual tests. Irrigation has also proved effective in increasing pasture production, especially through the summer. At one ARS station, pasture irrigation increased milk yield by 56 percent and raised income by 35 percent.

Maintenance of high quality is a greater problem in *harvested* forage crops than it is in such crops used as pasture. Harvested forage—whether hay or silage—must be of good quality so cows will eat plenty. And the supply must be abundant.

Much of the basic quality of a forage crop can be lost by harvesting it at the wrong time. Grasses and legumes make better hay and silage if harvested at an early stage of maturity. At that time, they provide top levels of digestibility and nutrients. Tests have shown that the greatest milk-producing value is provided by early-cut hay, the least by late-cut hay. Corn and sorghum, on the contrary, make the best silage if harvested when fairly mature. Corn should be cut when the kernels are well dented but the leaves are still green. Sorghum should be harvested when the seeds are hard and ripe.

In the last 14 years, national average milk yield has increased 1.44 pounds for each pound of increase in grain fed. To nutritionists, this means that grain supplied more than enough nutrients for the extra milk—and forage contributed little. They contend that a similar increase could have been obtained at less cost if more of the nutrients had been derived from good forage.

Experiments show that with usual grain feeding, cows should consume 2½ to 2¾ pounds of hay—or its equivalent in pasture or silage—per day per 100 pounds of body weight. To do this, they must have *good* forage, say the nutritionists.☆

Farm WALK-INS make refrigerator history

ENTHUSIASTIC users of two temperature walk-in refrigerators on four Maryland farms are helping USDA scientists learn about operating costs, management, and variations in design of this relatively new and increasingly popular equipment.

On the D. Walker dairy and tobacco farm, a smokehouse encloses an experimentally built walk-in with a 250-cubic-foot freezer and 100-cubic-foot chillroom. This reverses proportions of the original ARS walk-in design (AGR. RES., May–June 1953, p. 14). Of course, any such change calls for adjustments in refrigeration and construction directions.

The walk-in on the Walker farm is shared with neighbors—11 persons in all—to supplement home refrigeration. For the unit's lifetime—10 years or more—users have agreed to record food stored and removed and kinds and costs of repairs. After a year, records begin to show patterns. It has been entered 1,635 times during the year, with enormous use in the summer. Visits to the refrigerator ran 400 times a month in summer, 50 times a month in winter.

Current use ranged from 400 kilowatt hours in August to 55 in February. Records show that weather makes the difference—even with little use, current consumption rises on hot days. Operating cost has averaged a thrifty 213 kilowatt hours per month on the Walker box.

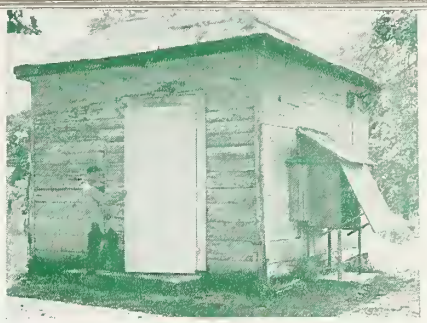
Meanwhile, a case history of the original-type walk-in is being kept on the Melvin Boone farm. Physicist E. McCracken of the ARS household-equipment laboratories had cautiously predicted that current might average 200 kilowatt hours per month, but Boone's figures show 163.

A turkey grower, H. T. Seitz, is keeping records on a walk-in of the same type, with this difference: frequent use of the chillroom to expand freezer storage by opening the partition door and running the chillroom compressor continuously. This compressor may wear out faster, but Seitz gains by freezing a load of turkeys when he wants to.

Fourth farmer with a walk-in case history is Arthur Bowen, who wanted bigger storage, for 400 to 600 turkeys. He built a unit with a 250-cubic-foot chillroom and a freezer 12 feet long—about five times as big as the original type. Three compressors were installed—2 of ½ horsepower each—for the freezer. A small blower unit replaced the gravity coil.

The family wanted this big unit in their basement, though not sure whether winter cold would freeze the ground and cause the floor to buckle. But sub-floor ventilation prevented this. Thermocouples have aided in keeping recordings that show ground temperatures—now in the 50's—will not go low enough to cause trouble.

Working drawings for the original ARS walk-in are reaching farm families through many State Extension engineers. A booklet of instructions has recently been produced to accompany these drawings, and some of the additional guidance has come from the Maryland case-history walk-ins.☆



EXPERIMENTAL walk-in on Walker farm is in 150-year-old smokehouse (instruments at right). A garage is used on Boone farm.

RECORDS are made weekly by Mrs. Walker of current use, temperatures, openings; she changes charts on recording-pressure gauge.

CHILLROOM holds "most everything" from ready-prepared foods to milk for orphan pigs, vaccine for stock, flowers for the church.

FREEZING ROOM, shared by four households, on Walker farm provides storage for roasts, crabs, chickens, baked breads, other foods.

Adding an antioxidant doubles shelf life of butter candies

More dairy butter may go into confections, as a result of recent findings by USDA researchers.

This showed that the shelf life of several popular candies containing butter can be at least doubled by adding yeast or a special oat flour to retard spoilage caused by oxidation of the fat. The Southern Regional Research Laboratory conducted these experiments in cooperation with the National Confectioners Association.

Candies contain fats in the form of added butter, hydrogenated oil, nuts, coconut, and chocolate. The stability of these fats is extremely important to the shelf life of the candy. Several factors determine stability—amount of exposure to air, storage temperature, and presence of a natural or added substance called an antioxidant that will retard fat deterioration.

Unfortunately, butter doesn't contain a natural antioxidant. When butter candies are stored for several weeks or months, particularly at summer temperatures, the formation of peroxides makes the butterfat so rancid that the candy eventually becomes unsalable.

But the addition of about 3 percent of oat flour or debittered brewers yeast—both known to contain antioxidants—to the butter will give candies adequate shelf life. And in this range of concentration, the added products don't give detectable flavors in most candies.

ARS researchers found that candies prepared with brewers yeast and butter remained free of rancidity 2 to 6 times as long. Yeast protected fudge and butter creams—even in continual storage at 86° F.—for 16 to 19 weeks, whereas unprotected creams were noticeably rancid in 2 to 3 weeks. Standard butter mints kept only 8 to 9 weeks, but with yeast or oat flour they remained free of oxidative off-flavor for 16 to 19 weeks.☆

New processes will make rice quicker to prepare—and better

Many housewives have difficulty preparing rice dishes that are as palatable as they might be. In an effort to popularize this food, USDA's Western Regional Research Laboratory has developed more convenient forms or modifications for rice preparation.

One of these is canned cooked white rice. An improved method worked out by ARS scientists yields a product with the desirable qualities of whiteness, flavor, and grain separation that are common to well-prepared rice. The product is made ready for serving by adding a small quantity of boiling water, or by immersing the can in boiling water for a short time.

Frozen cooked white or brown rice offers the usual advantages of frozen foods—convenience and time-saving in meal preparation. After 8 months storage at −10° F., this product showed no deterioration and had lost none of its palatability as a result of freezing.

Under development is a type of quick-cooking rice. It promises to reduce preparation time still more. Studies are being made to discover what changes occur during the various parboiling treatments and to find methods that will improve color and flavor.

Western Laboratory rice investigations also include studies of the physical and compositional changes that take place in storage, as well as techniques for determining storage stability of rice and rice products.

Canned and frozen cooked rice can well be used by manufacturers of prepared foods such as chicken and rice and Spanish rice. Inquiries from commercial concerns indicate wide interest in the developments.☆

Research shows how to improve frozen or canned apple slices

Know-how pays well when a homemaker wants to freeze or can apple slices to have them appetizingly ready for pies, fruit cocktail, or salad.

Experiments in USDA home-food-preservation laboratories show how various treatments affect color freshness, texture, and flavor of this delicate cut fruit.

The findings reported by ARS food specialists Elsie H. Dawson, Olivia Hammerle, and Mary Smith suggest these improved directions for homemakers:

Like the researchers, you'll get best results by starting with suitable fruit that's firm and crisp.

Frozen apple slices need some treatment to retard browning, softening, and flavor loss. Packing raw slices in dry sugar or sugar sirup, with ascorbic acid (vitamin C) added, is effective. And so is preheating in steam and packing with or without sweetening.

Packing slices raw for home canning yields a better quality product than the hot-pack method of quick heating before canning. Raw-packed slices aren't improved by adding ascorbic acid; the canned fruit holds flavor and color well enough without it.

Pre-treatment with calcium salts has been suggested to prevent excessive softening when apples for home canning or freezing aren't firm to start with. This may toughen firm fruit, the experiments showed.☆

FINDINGS ON FOULBROOD

SOME HONEYBEES HAVE BUILT-IN RESISTANCE to the contagious disease American foulbrood. This bee-larvae disease often destroys entire colonies, yet in others where infection is introduced, it never develops.

USDA bee physiologists discovered that part of this reason for resistance resulted from the greater ability of some bees to filter out from nectar or honey in their stomachs the tiny disease organisms (*Bacillus* larvae) that cause American foulbrood. In colonies of such bees most of the disease organisms were eliminated outside the hive. Those that remained in the stomach and were deposited with the honey in the comb were too few in number to cause infection of bee larvae. (American foulbrood affects only honeybee larvae—it doesn't trouble man.)

An equal, or perhaps more important, factor that helps explain the good health bees generally enjoy is their ability to keep a clean house. In most cases, healthy colonies are those that detect the presence of disease in its early stages. Sick bee larvae are cleaned from the cells and removed from the hive so quickly by such colonies that disease never gets a foothold. The poorer housekeepers, on the other hand, allow infectious material to accumulate—often in such quantities that it dooms the hive.

Cooperative tests carried out by ARS and the Wyoming Agricultural Experiment Station at Laramie showed that the physiologically resistant bees fed on a disease-laden sugar syrup were able to remove from 72 to 84 percent of the *Bacillus* larvae in their stomachs. But bees from susceptible colonies removed only 43 to 74 percent of the larvae.

The internal organ that does the job for the resistant bee is called the honey stopper, a clover-leaf-like valve connecting the honey stomach with the pro-ventriculus, another section of the stomach. This valve is lined with tiny hairs that are capable of filtering out small suspended particles, such as pollen and disease organisms.☆

Readers' REACTIONS

Under control:

SIR: Mention is made [Aug. 1954, p. 3] of mercury-vapor light traps and of controlling the spectral character of the energy released by coating the inner surface of the glass tubes with various phosphorescent materials.

It is believed that insect infestations in Navy warehouses used for the storage of subsistence items present situations in which light traps with controlled spectral characteristics would be of value.

Any information which you can furnish on construction and use of such traps would be greatly appreciated.—ROBERT Z. PAGE, Director, Pest Control Division, Fifth Naval District, Norfolk, Va.

● A researcher furnished Mr. Page the information he needed.—ED.

Window shopper:

SIR: Information from your magazine was used as the basis of a window exhibit dealing with the effect of light on plants (May–June, July 1953, June 1954) at the Forksville (Pa.) Fair.

S. B. Hendricks was very helpful in giving us the details which made it possible for us to duplicate the results.

Next year we plan an exhibit on how solar energy can be used to heat farm buildings. We would appreciate an article on the latest findings.—C. L. KOCHER, Turnpike School System, Mildred, Pa.

● Solar-energy work in connection with heat-pump research [Nov. 1953, p. 14] will be reported when further along.—ED.

Best of worst:

SIR: You may be interested to know that Dr. G. F. Heuser, editor of World's Poultry Science Journal, wrote me for pictures to be used in reproducing "Lymphomatosis, Poultry's Worst Disease" [June 1954, p. 4].—BERLEY WINTON, Director, Regional Poultry Research Laboratory, East Lansing, Mich.

● This article has been reprinted in many popular as well as scientific publications. We are glad to follow up with news of a significant advance made against lymphomatosis (p. 4).—ED.

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AGRISEARCH Notes

RESISTER: Delus potato

Delus, a new potato adapted to Delaware growing conditions, is outstanding because of its immunity to common races of late-blight fungus. For this reason, it's expected to become an important variety in that State.

The new potato yields as well or better than Katahdin and Irish Cobbler, the standard Delaware potatoes, and has good marketing and cooking qualities. Its tubers are smooth-skinned with white flesh and shallow eyes.

USDA's Agricultural Research Service and the Delaware experiment station have released Delus to certified seed producers for increase. Limited quantities of seed should be available for farm planting next spring.☆

BALANCE: tung nutrition

A 13-year experiment with nutritive supplements for tung trees has enabled USDA to improve recommendations for fertilizing these oil-bearing trees when grown in the Red Bay soils of Mississippi. Work was begun by the late G. M. Bahrt and continued by ARS scientists S. Merrill, Jr., G. F. Potter, and R. T. Brown.

To provide balanced rations for mature tung trees in these soils, fertilizer supplying approximately 1.5 pounds each of nitrogen and potassium per tree and 0.5 pounds of phosphoric acid is recommended. Trees getting these proportions were resistant to cold and produced high yields of oil. (Less potassium and more phosphorus proportionately have generally been advised.)

Applying a high level of nitrogen in relation to potassium caused a severe potassium deficiency. As a result, many trees died of cold injury. High nitrogen greatly increased fruit yield but reduced oil content.☆

PROCESS: insole leather

Shoes are likely to last longer if insoles are treated with basic aluminum acetate, say USDA chemists C. W. Beebe, W. F. Happich, W. S. Kip, and J. S. Rogers. They have developed an alum-retanning process that increases insole durability about 70 percent.

The leather was first tanned as usual with vegetable extracts, then retanned with basic aluminum acetate. This chemical builds up resistance to acid deterioration, moist heat, and molds. Laboratory tests showed alum-treated leather 81 percent better in tensile strength.

Philadelphia postmen gave these new insoles the acid test—daily wear for 9 to 12 months. After original outsoles and two resoles were worn through, 85 percent of the alum-retanned insoles but only 49 percent of the ordinary insoles were still worth repairing.

Industry can easily fit the process to normal tanning operations by adding alum to the other materials that are drummed into leather in the tanner's oil wheel, or by "dry dipping" insoles into an alum solution.☆

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